Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band	ET Docket No. 13-49

REPLY COMMENTS OF NCTA—THE INTERNET & TELEVISION ASSOCIATION REGARDING THE OFFICE OF ENGINEERING AND TECHNOLOGY'S REPORT ON PHASE I TESTING OF PROTOTYPE U-NII-4 DEVICES

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I. INTRODUCTION AND SUMMARY

In its Public Notice, the Office of Engineering and Technology (OET) sought comment on two important items. First, it requested analysis of its technical report (Report), which supports a finding that Wi-Fi devices can operate in the 5.9 GHz band without causing harmful interference to Dedicated Short Range Communications (DSRC) systems. Second, it requested comment on how the significant developments in the years since the test plan was announced should impact OET's evaluation of the test results, its previous test plan, and the Federal Communications Commission's (Commission or FCC) larger proceeding on opening the band to Wi-Fi.[1] Nonetheless, only a handful of DSRC supporters provided technical analyses of OET's Report. Instead, most DSRC supporters merely rehashed high-level advocacy on DSRC and argued for delay. None of the comments filed by DSRC interests provide analysis that call OET's findings into question.

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[1] *Office of Engineering and Technology Requests Comment on Phase I Testing of Prototype U-NII-4 Devices*, Public Notice, ET Docket No. 13-49, Attach. A (rel. Oct. 29, 2018) (the Phase I Public Notice and attached Report).

NCTA therefore files these reply comments to respond to errors and mischaracterizations related to adjacent-channel interference in the few comments by DSRC supporters that provided technical responses to the Report. The Report confirms that band segmentation successfully protects adjacent-channel DSRC operations, and DSRC proponents' concerns about those results are unfounded. Given significant changes in the communications and automotive marketplaces since the test plan was adopted, the Commission should reject calls for wasteful additional testing that will further delay FCC action to bring the failed 5.9 GHz band into use for the country. Instead, it should move forward with a Further Notice of Proposed Rulemaking (FNPRM) proposing to re-designate the band for unlicensed operations or, as the Report describes is amply feasible, segment the band to allow adjacent Wi-Fi and DSRC operations. The FNPRM can seek comment on how Commission rules should address any adjacent-channel concerns.

II. OET'S REPORT SUPPORTS COMMISSION ACTION TO FIX THE UNDERUTILIZED 5.9 GHZ BAND.

As NCTA and others have explained, FCC action is urgently needed to address the underutilization of the 5.9 GHz band. While the Commission works hard to identify new bands to support the nation's economy, the 5.9 GHz band remains completely unused in almost every U.S. community, every day. Given the growth of alternative automotive technologies, the failure of DSRC, and significant changes in the surrounding spectrum environment, the Commission should propose to repurpose the entire 5.9 GHz band for unlicensed operations—thereby extending the existing U-NII-3 band and giving Americans a powerful new 160-megahertz channel to support Wi-Fi.

If, however, the Commission decides to retain a portion of the band for future automotive safety-of-life operations, it could segment the band to designate at least 45 megahertz at the bottom of the band for unlicensed operations while reserving exclusive spectrum for safety-

critical DSRC operations in the top three channels.[2] In that scenario, the Report's conclusion that Wi-Fi devices operating at real-world power levels can reliably protect DSRC from adjacent-channel interference becomes important.

The Report found that even without a guard band or specialized filter, "the probability of interference due to adjacent channel operation [was] considerably less" than the already low risk of co-channel interference OET tested.[3] That is true even though OET made conservative design choices that likely overstate the likelihood of harmful interference from adjacent-channel operations. Even if DSRC were to become pervasive—which the last 20 years suggests will not be the case—it is extraordinarily unlikely in the real world that Wi-Fi operations will cause a meaningful reduction in DSRC packet completion rates.[4] To arrive at this conclusion, the Report adopted, among other conservative assumptions, an overprotective packet completion rate expectation, a Wi-Fi duty cycle level that is far more aggressive than real-world operations, and a worst-case DSRC power level.[5] Additionally, OET's test setup, which connected a Wi-Fi

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2 As explained in NCTA's comments, this approach allows for the creation of two new 20-megahertz channels and for joining the remaining 5 megahertz with the adjacent U-NII-3 band to facilitate a contiguous 160-megahertz channel. Comments of NCTA—The Internet & Television Association Regarding the Office of Engineering and Technology's Report on Phase I Testing of Prototype U-NII-4 Devices, ET Docket No. 13-49, at 3 (filed Nov. 28, 2018) (NCTA Comments). Because that large channel is essential to advanced Wi-Fi operations, Autotalks's suggestion that the Commission carve a guard band out of the lower 40 megahertz would destroy much of the band's value. *See* Letter from Onn Haran, CTO, Autotalks LTD, to Matthew Hussey, Office of Engineering and Technology, FCC, ET Docket No. 13-49, at 2 (filed Nov. 28, 2018) (Autotalks Comments). It is also unnecessary, as OET's results show that band segmentation protects DSRC even without a guard band.

3 Report at 97.

4 *See* NCTA Comments at 3-10.

5 *Id.*

device to a DSRC device using a cable, assumed less signal loss than would occur in the real world.[6]

Nonetheless, using this conservative test protocol, the Report supports the conclusion that the probability of harmful interference to DSRC from adjacent-channel Wi-Fi operations—even where Wi-Fi is operating with no spectral separation and with no specialized mask—is vanishingly small. In the worst-performing configuration OET tested, the probability that adjacent-channel Wi-Fi would reduce DSRC's packet completion rate below 90 percent was just 0.07 percent.[7] And adjacent-channel interference that reduces DSRC packet completion to less than 50 percent was significantly rarer.[8]

Some DSRC proponents attempt to spin this gold into straw. For example, Toyota argues that the Report's Figure 11 somehow suggests an adjacent-channel interference problem because it shows that "a U-NII-4 device operating with the proposed maximum transmit power of +36 dBm Equivalent Isotropically Radiated Power (EIRP)" on the first-adjacent channel to DSRC "could experience 96 dB of attenuation and still drown out critical DSRC transmissions."[9]

Toyota's analysis is flawed because it is based on unfounded assumptions. Toyota assumes, for example, that a U-NII-4 device is operating at 36 dBm EIRP and that the signal is attenuated only by free space loss. In the real world, Wi-Fi received signal strengths are far lower than Toyota's faulty assumptions would produce. Field measurements of outdoor Wi-Fi access points, assessed through 50,000 individual measurements taken on multiple days, shows

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6 *Id.* at 7.

7 *Id.* at 8-9.

8 *Id.* at 9.

9 Comments of Toyota Motor Corporation, ET Docket No. 13-49, at 4 (filed Nov. 28, 2018) (Toyota Comments).

typical Wi-Fi received signal strength of -60 dBm or less.[10] In the real world it is extremely rare that Wi-Fi would produce received power levels that could cause DSRC packet reception of less than 90 percent—much less actual harm to DSRC operations—even under OET's conservative testing parameters.[11] Additionally, Toyota's calculations incorrectly assume only free-space signal loss, ignoring other propagation factors, such as signal fading, that can contribute to additional signal loss between an unusually high-powered Wi-Fi access point and a passing car. Furthermore, outdoor access points are generally placed in settings like parks and stadiums where Wi-Fi users gather outside. Those environments typically feature trees and other obstructions that attenuate the signal, making Toyota's assumption unrealistic.

Autotalks, DENSO, and IEEE's DSRC committee contend that the Commission somehow did not consider "outdoor access point[s]" in its adjacent-channel analysis.[12] The IEEE DSRC committee, for example, argues that the Commission should have tested scenarios "in which a U-NII-4 device operates in an elevated outdoor high power (36 dBm EIRP) setting (modeling a public Wi-Fi hotspot)."[13] The premise of that argument is the same as the flawed Toyota analysis discussed above—that signals from these access points will reach DSRC

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[10] *See* Letter from Paul Margie, Counsel to NCTA, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, attachment at slide 9 (filed June 28, 2017) (June 2017 NCTA Letter).

[11] Notably, Toyota does not say what packet-error rate constitutes "drown[ing] out critical DSRC transmissions." Toyota Comments at 4. As NCTA's comments explain, DSRC was designed to operate in noisy environments and meet performance expectations even when some packet loss occurs. NCTA Comments at 5. Packet loss does not, therefore, necessarily equate to harmful interference.

[12] Autotalks Comments at 2; Letter from Pat Bassett, Vice President, NA Research and Engineering Center, DENSO International America, Inc., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at 2 (filed Nov. 28, 2018) (DENSO Comments).

[13] Letter from Thomas M. Kurihara, Chair, IEEE 1609 DSRC Working Group, et al., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at 2 (filed Nov. 28, 2018) (IEEE 1609 Comments).

receivers at power levels higher than the levels OET found to produce 90 percent or higher DSRC packet completion rates (*i.e.*, stronger than approximately -50 to -60 dBm). But this is incorrect. As described above, CableLabs' extensive real-world tests of outdoor access points show that received power levels stronger than those OET considered are extremely unlikely.[14] IEEE's DSRC committee fails to present any testing that is inconsistent with this finding.

Toyota and DENSO also argue that "it would be permissible for a U-NII-4 device to impart 10 to 15 dB more interference energy in these channels than was measured by the prototype devices."[15] But OET's test protocol correctly accounted for Wi-Fi power. Most Wi-Fi devices have transmit power levels below 30 dBm and antenna gain levels below 6 dBi. And again, field measurements confirm that in the real world, *received* power levels that are higher than those OET tested are very unlikely—and received power is far more relevant than transmitted power because only received power levels are relevant to DSRC packet completion rates.[16] Moreover, DSRC proponents ignore a critical aspect of OET's conservative test design: OET tested these power levels at duty cycles that simulate many simultaneously operating Wi-Fi devices, not a single device or even a handful of devices.[17]

Finally, Autotalks argues that OET should have tested the effect of adjacent-channel interference on DSRC signal levels as low as -92 dBm rather than -90 dBm.[18] But this would have improperly tested the devices using DSRC signal levels below those that DSRC can consistently receive even under ideal conditions. OET's sensitivity testing of the DSRC

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14 *See* June 2017 NCTA Letter, attachment at slide 9.

15 Toyota Comments at 6; *see* DENSO Comments at 2 ("output power was low . . . and the spectral skirts were 10 to 20dB below allowed mask limits").

16 June 2017 NCTA Letter, attachment at slide 9.

17 *See* NCTA Comments at 6.

18 Autotalks Comments at 2.

receivers submitted for testing revealed that half of these DSRC devices could not receive packets at -92 dBm without errors, even in a completely interference-free environment.[19] Thus, testing the effect of interference on DSRC devices at a DSRC received signal strength of -92 dBm would have confounded these tests by introducing packet loss that was not caused by interference and therefore would not have served as an appropriate baseline against which to measure the effect of an interfering signal.

III. PHASES II AND III OF THE COMMISSION'S 2016 TEST PLAN ARE NO LONGER RELEVANT.

Since the beginning of this proceeding, DSRC proponents have engaged in a series of rearguard delay tactics, hoping to forestall Commission action to fix the underutilized 5.9 GHz band. Their latest attempt is to argue that the FCC should postpone further action on the band until it conducts multiple additional phases of a test plan that are no longer relevant.[20] Incredibly, DSRC proponents simultaneously argue that the detect-and-vacate approach will not work, but that the Commission must continue to test it rather than replacing it with the more reasonable band-segmentation approach. After two decades of waiting for DSRC to deploy, the Commission should not tolerate this clear delay tactic. As multiple commenters note, the "spectrum uncertainty" created by lengthy testing "critically impact[s]" the development of

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[19] *See* Report figs. 6-9.

[20] *See*, *e.g.*, Letter from Carlos M. Braceras, President, American Association of State Highway and Transportation Officials, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at 1-2 (filed Nov. 26, 2018); DENSO Comments at 1-3.

automotive-safety technologies,[21] just as it robs the public and the economy of the billions of dollars of benefits of freeing up new spectrum for unlicensed uses.[22]

Fortunately, modernizing the 5.9 GHz band through re-designation or band segmentation does not require additional testing. The remaining phases of the test plan focus on co-channel sharing. As NCTA discussed fully in its opening comments, that approach no longer merits the government resources or time that would be wasted in Phases II and III. OET's existing results are more than sufficient to allow the Commission to pursue an FNPRM, and the Commission can determine appropriate technical rules related to adjacent-channel operation as part of the rulemaking process.

A. The Commission Should No Longer Consider the Detect-and-Vacate Approach and Should Not Waste Resources on Further Co-Channel Testing.

While the Report supports band segmentation, the record makes it clear that co-channel operation of Wi-Fi and safety-of-life DSRC would not advance the public interest. As NCTA explained in its opening comments, co-channel operation of Wi-Fi and safety-of-life DSRC would be unnecessarily complex, costly, burdensome, and require heavy-handed regulation.[23] Comments from other parties, including DSRC interests, support this finding, raising questions

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[21] Letter from Glen De Vos, Senior Vice President, Aptiv, et al., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at 2, 6 (filed Nov. 27, 2018) (Aptiv Comments); *see also*, *e.g.*, Letter from R. Earl Lewis, Deputy Secretary, Maryland Department of Transportation, to Ajit Pai, Chairman, FCC, ET Docket No. 13-49, at 1 (filed Nov. 26, 2018) (urging Commission to "end the uncertainty" regarding the future of the band).

[22] *See*, *e.g.*, Diana Gehlhaus Carew et al., RAND Corporation, *The Potential Economic Value of Unlicensed Spectrum in the 5.9 GHz Frequency Band* ix-x (2018), *available at* https://www.rand.org/pubs/research_reports/RR2720.html (preliminary estimate of "total gains to economic welfare in the form of consumer and producer surplus" from full re-allocation of the 5.9 GHz band for "open unlicensed use" "rang[ing] from $82.2 billion to $189.9 billion").

[23] *See* NCTA Comments at 11-12.

regarding the proper "channel-move time,"[24] potential "radiated power imbalance" issues in "co-channel" situations,[25] and other problems.[26] The complex FCC rules needed to address these concerns, and the commercial impossibility of vacating the entire U-NII-4 band when a Wi-Fi access point detects even a single signal from a single DSRC device, would likely lead the nation's largest Wi-Fi network providers to avoid U-NII-4 deployment altogether.

The Commission should therefore heed the call to "move past" this detect-and-vacate "type of sharing regime" and "initiate a rulemaking" to consider re-designating the band for unlicensed operations or a band-segmentation approach.[27] Once the Commission concludes that it will no longer pursue the detect-and-vacate approach, it need not continue to consider co-channel operation in additional phases of testing.

B. Further Testing of Adjacent-Channel Interactions Is Unnecessary.

As discussed above, OET's findings regarding adjacent-channel interference provide the foundation for issuing an FNPRM considering band segmentation along with re-designation of the entire band. Some commenters have suggested that the Commission should pursue further testing before proposing band segmentation or taking any further steps in this proceeding. But none of the questions these commenters have raised warrant additional testing or delay.

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[24] *See* Aptiv Comments at 3-4; IEEE 1609 Comments at 3.

[25] *See* DENSO Comments at 2.

[26] *See* Aptiv Comments at 4-5 (describing "[m]issing" tests for the detect-and-vacate approach); Comments of Motor & Equipment Manufacturers Association, ET Docket No. 13-49, at 3 (Nov. 28, 2018) (identifying "significant concerns about the widely varying channel move times cited in" the Report); IEEE 1609 Comments at 3 (calling for "careful scrutiny" of "the exact process by which a [detect-and-vacate] device can resume transmissions in the 5.9 GHz band after previously vacating").

[27] Statement of Commissioner Michael O'Rielly on 5.9 GHz Phase I Testing Data (Oct. 29, 2018), https://docs.fcc.gov/public/attachments/DOC-354831A1.pdf.

Some commenters suggest that further adjacent-channel testing is needed to evaluate devices operating in 40-, 80-, or 160-megahertz-wide channels, as opposed to the 20-megahertz-wide channels in OET's testing, because "the interference characteristics" of these channels would be "different."[28] More specifically, Toyota argues that "out-of-channel energy would be spread over a greater spectral range," which may affect adjacent-channel interference results.[29] But the Commission has received information on this topic previously as well, and it is clear that wider channels would impart significantly *less* power into the first-adjacent channel than would a 20-megahertz channel.[30] That is because the same "total power restriction" applies regardless of the size of the channel, leading to lower power spectral density as channel size expands.[31] In other words, as illustrated in the figure below from NCTA's June 2017 letter,[32] while Toyota is correct that out-of-band emissions reach farther under wider channelization, the impact on the channel most affected by those emissions—the first-adjacent channel—is diminished, and the power that reaches other nearby channels is even lower. Testing 20-megahertz channels was the most conservative choice OET could make.

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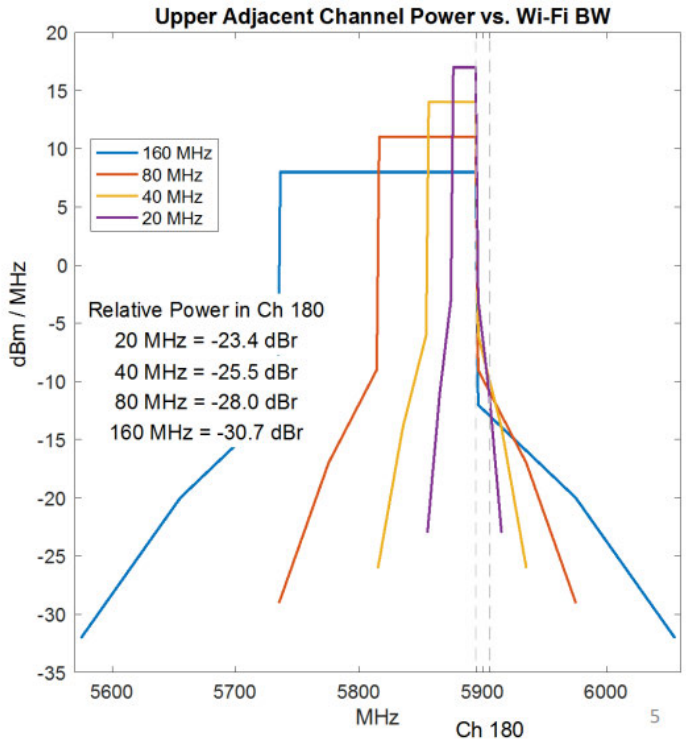
28 IEEE 1609 Comments at 2.

29 Toyota Comments at 14.

30 June 2017 NCTA Letter, attachment at slide 5.

31 *Id.*

32 *Id.*



Toyota and IEEE's DSRC committee also suggest that the Commission should conduct further adjacent-channel testing on "non-Wi-Fi U-NII-4 devices, for example LTE-LAA or LTE-U, since a major tenet of the Re-channelization proposal is to achieve mutual detection between DSRC and U-NII-4" in the lower channels of the band.[33] But the premise of that suggestion is mistaken—as NCTA explained in its opening comments, band segmentation need not and should not include detect-and-avoid protocols for *non-safety-of-life* DSRC use cases that may seek to use the lower portion of the band.[34] Instead, a central benefit of unlicensed spectrum is that devices that comply with technical rules governing fundamental issues like power levels and spectral masks can coexist. U-NII-4 devices that did not use Wi-Fi would need only comply with rules the Commission set out—just as would be the case with DSRC devices seeking to use these lower channels on an unlicensed basis.

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[33] IEEE 1609 Comments at 2; *see also* Toyota Comments at 13.

[34] NCTA Comments at 4 n.8, 12 n.25.

Finally, Toyota and Cisco argue that the Commission should delay action in the band in order to test adjacent-channel scenarios involving DSRC services beyond the basic safety message (BSM) and involving other (not unlicensed) services. Toyota says "OET should fully examine the potential for cross-channel DSRC-to-DSRC interference created by placing high power public safety communication . . . near the [Basic Safety Message], as well as possible interference to the [Basic Safety Message] from the Fixed Satellite Service operating in the adjacent band."[35] Cisco also suggests that additional testing is needed to address non-basic safety message operations, like "managing snow removal."[36]

Toyota's and Cisco's assertions that OET's adjacent-channel testing was incomplete or inadequate are wrong. OET was limited to available prototypes, and no company submitted a DSRC device with operations beyond the BSM. This is because DSRC devices are not widespread or commercialized—and exactly why it is time to recognize that DSRC has been a commercial failure. Many of the non-BSM operations envisioned by DSRC proponents appear to have been subjected to only limited and highly subsidized pilot deployments, and many are not safety-critical or latency sensitive.[37] In fact, the high-power DSRC operations in Channel 184 are so sparse that automakers and other members of 5GAA, in their proposal for C-V2X to access that part of the band, propose to transition them all to other channels or convert them to C-V2X.[38] Nonetheless, if these services become concrete enough to merit consideration, they can also be addressed in the FNPRM and do not require additional testing. More fundamentally,

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35 Toyota Comments at 15.

36 Comments of Cisco, ET Docket No. 13-49, at 3 n.4 (filed Nov. 28, 2018).

37 *See*, *e.g.*, National Operations Center of Excellence, SPaT Challenge Overview, https://transportationops.org/spatchallenge (last visited Dec. 10, 2018) (showing that state governments have implemented Signal Phase and Timing vehicle-to-infrastructure DSRC systems at only 216 intersections *nationwide*).

38 5GAA Petition for Waiver, GN Docket No. 18-357, at 28 n.74 (filed Nov. 21, 2018).

it would be a mistake to halt progress in the 5.9 GHz band to give DSRC proponents even more time to search for reasonable, scalable uses for the technology after twenty years with no success—and while the automotive-safety industry decides between DSRC and C-V2X. Issuing an FNPRM will allow all parties to discuss these issues on the record rather than rewarding further just-around-the-bend delay tactics.

IV. THE 5.9 GHZ BAND REMAINS CRITICAL TO THE FUTURE OF WI-FI.

In an attempt to sidestep the failure of DSRC to deploy in the 5.9 GHz band, some commenters assert that the Commission's proposed actions in the 6 GHz band "rais[e] the question whether the 75 MHz in the 5.9 GHz band is still needed for Wi-Fi."[39] The Commission's proposed approach in the 6 GHz Notice of Proposed Rulemaking includes indoor-versus-outdoor use restrictions, low-power limitations, available-frequency databases, and other coexistence mechanisms designed to accommodate the important incumbent users of the 6 GHz band.[40] The 5.9 GHz band, unlike 6 GHz, has no substantial incumbent operations, and the re-designation or band-segmentation approaches would allow the FCC to combine the U-NII-3 and U-NII-4 bands to provide the country with a contiguous 160-megahertz channel free from coexistence mechanisms such as low power, indoor restrictions, and database use. This would produce a far different resource than the 6 GHz band, and would more easily support the outdoor Wi-Fi access points and low-cost consumer devices found in the U-NII-3 band today. Because of this, as Commissioner O'Rielly has noted, potential action on the 6 GHz band does not replace

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[39] Letter from Jason M. Conley, Executive Director, OmniAir Consortium, Inc., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at 7 (filed Nov. 28, 2018); *see also* IEEE 1609 Comments at 4.

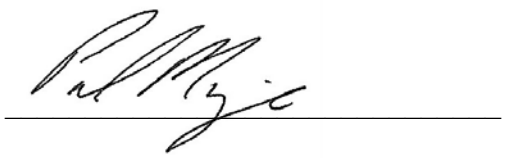
[40] *See*, *e.g.*, *Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Proposed Rulemaking, ET Docket No. 18-295, GN Docket No. 17-183, ¶¶ 8-25 (rel. Oct. 24, 2018).

the need to act on the 5.9 GHz band.[41] The best way to do so would be for the Commission to move forward with an FNPRM that proposes to designate the entire 5.9 GHz band to unlicensed services and seeks comment on which other bands could support automotive safety applications.

V. CONCLUSION

OET's Report confirms that band segmentation is a viable approach to unlock critical unlicensed spectrum while accommodating DSRC. The Commission should issue an FNPRM to take a fresh look at the 5.9 GHz band without delay.

Respectfully submitted,



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[41] *See*, *e.g.*, Statement of Commissioner Michael O'Rielly, ET Docket No. 18-295, GN Docket No. 17-183 (Oct. 23, 2018) (the 5.9 GHz band is "the missing link between the 5 GHz and 6 GHz bands"); Statement of Commissioner Jessica Rosenworcel, ET Docket No. 18-295, GN Docket No. 17-183 (Oct. 23, 2018) ("the 6 GHz band and 5.9 GHz band are the right place to start" for additional Wi-Fi spectrum).